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(72) Inventors GORDON MURRAY WADDINGTON, ANDRAS SZUCS and THOMAS EDWARD BANKS

(54) BUILDERS FORMWORK

(71) We, MILLS SCAFFOLD COMPANY LIMITED, a British Company of Winchester House, 53/55 Uxbridge Road, Ealing, London W5 5SE, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be perofrmed, to be particularly described in and by the following statement:—

This invention relates to builders' formwork used in the casting of concrete structural elements such as floors and decks and of the kind, hereinafter referred to as being of the kind specified, comprising a plurality of vertical scaffold elements, each scaffold element supporting an upper head and a stripped out and used again but the upper heads are left supporting the concrete for a further period of time, for example, fourteen days.

Heretofore, when using, for example, moulds or panels as forms in formwork of the kind specified, the distance between adjacent support beams has been equal to the width of a row of moulds or panels. Particularly when moulds are used, which are of standard dimensions, the vertical scaffold elements may not be stressed to their maximum allowable load so that the formwork uses more vertical scaffold elements than necessary to take the total load, that is the formwork uses the elements inefficiently.

PATENTS ACT 1949

SPECIFICATION NO. 1457136

The following corrections were allowed under Section 76 on 3 December 1976

Page 1, line 1 (71) *after* We, *insert* GKN MILLS BUIDLING SERVICES LIMITED, formerly known as,

THE PATENT OFFICE
4 January 1977

Bas 33221/'

Formwork of the kind specified is well known and is used in the casting of a floor or deck as follows. The plurality of vertical scaffold elements are inter-connected by the support beams and with their lower heads in an upper operative position the support beams are arranged to have their upper surfaces flush with the upper surfaces of the upper heads. The forms are then supported on the support beams and the concrete floor or deck is cast. After, for example, three days, the lower heads are lowered thus lowering the support beams and the forms while leaving the upper heads in contact with, and supporting, the floor or deck. The support beams and forms can then be [illegible] horizontal primary beams extending between and engaged with the lower heads of adjacent scaffold elements, a plurality of mutually parallel horizontal secondary beams extending between and engaged with the lower heads of adjacent scaffold elements, the primary and secondary beams being arranged at right angles to each other so that the beams engaged with four scaffold elements arranged at the corners of a rectangle are two primary beams and two secondary beams and lie along the sides of the rectangle, an intermediate secondary beam supported from and extending between the primary beams on opposite sides of a rectangle, the upper surfaces of all the secondary beams and of the upper heads

SEE CORRECTION SLIP ATTACHED

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This invention relates to builders' formwork used in the casting of concrete structural elements such as floors and decks and of the kind, hereinafter referred to as being of the kind specified, comprising a plurality of vertical scaffold elements, each scaffold element supporting an upper head and a lower or drop head, a plurality of parallel support beams supported by the lower heads of the scaffold elements and a plurality of forms such as moulds or panels supported by the support beams and forming a casting surface for the soffit of the structural element to be cast. The invention is also concerned with scaffolding for formwork of the kind specified.

Any suitable form of scaffold element may be used. For example, double-headed props of variable length may be used to support the support beams or alternatively the upper and lower heads may be supported on vertical scaffold poles which may form part of a builders' scaffolding.

Formwork of the kind specified is well known and is used in the casting of a floor or deck as follows. The plurality of vertical scaffold elements are inter-connected by the support beams and with their lower heads in an upper operative position the support beams are arranged to have their upper surfaces flush with the upper surfaces of the upper heads. The forms are then supported on the support beams and the concrete floor or deck is cast. After, for example, three days, the lower heads are lowered thus lowering the support beams and the forms while leaving the upper heads in contact with, and supporting, the floor or deck. The support beams and forms can then be stripped out and used again but the upper heads are left supporting the concrete for a further period of time, for example, fourteen days.

Heretofore, when using, for example, moulds or panels as forms in formwork of the kind specified, the distance between adjacent support beams has been equal to the width of a row of moulds or panels. Particularly when moulds are used, which are of standard dimensions, the vertical scaffold elements may not be stressed to their maximum allowable load so that the formwork uses more vertical scaffold elements than necessary to take the total load, that is the formwork uses the elements inefficiently.

It is an object of one aspect of the invention to provide a scaffolding for formwork of the kind specified in which efficient use is made of the vertical scaffolding elements.

According to a first aspect of the invention, we provide such a scaffolding for supporting forms to the soffit of a structural element to be cast comprising a plurality of vertical scaffold elements each supporting an upper head and a lower or drop head movable vertically relative to the upper head between an upper or operative position and a lower or stripping position, the scaffold elements being arranged at the corners of rectangles, a plurality of mutually parallel horizontal primary beams extending between and engaged with the lower heads of adjacent scaffold elements, a plurality of mutually parallel horizontal secondary beams extending between and engaged with the lower heads of adjacent scaffold elements, the primary and secondary beams being arranged at right angles to each other so that the beams engaged with four scaffold elements arranged at the corners of a rectangle are two primary beams and two secondary beams and lie along the sides of the rectangle, an intermediate secondary beam supported from and extending between the primary beams on opposite sides of a rectangle, the upper surfaces of all the secondary beams and of the upper heads

forming parts of a casting surface for the soffit, and support surfaces on the sides of the secondary beams for supporting said forms between adjacent secondary beams, said support surfaces being above the upper surfaces of the primary beams.

Throughout this specification although the primary and secondary beams are referred to as being horizontal it is to be understood that this term includes such beams when arranged at a small inclination to the horizontal, not exceeding 7 degrees, as may occur, for example, when formwork in accordance with the invention is used to cast a decking having a drainage slope. Also, the term "vertical" as applied to the scaffold elements includes such elements when erected at the maximum possible deviation from the true vertical which safety considerations will allow.

It is an object of a second aspect of the invention to provide formwork of the kind specified which makes more efficient use of the vertical scaffold elements than does formwork at present in use.

According to this aspect of the invention, we provide formwork for the casting of a structural element comprising scaffolding according to the first aspect of the invention with forms supported between adjacent secondary beams on the support surfaces so that the lowermost parts of the forms are above the upper surfaces of the primary beams, there being a single row of forms between each adjacent pair of secondary beams.

By the foregoing arrangement, the size of the rectangles at the corners of which the scaffold elements are positioned can be chosen so that the scaffold elements are positioned in the most efficient positions for the particular job in hand. In particular, the width of such rectangles is not limited to the width of a single row of forms.

There may, for example, be two or more intermediate secondary beams supported from and extending between the primary beams on opposite sides of at least one of the rectangles. In such an arrangement a rectangle having two or more intermediate secondary beams will have three or more rows of forms supported between the beams engaged with the drop heads.

An important advantage of supporting the lowermost parts of the forms above the upper surfaces of the primary beams is that this gives complete freedom as to the dimensions of the forms in directions parallel to the secondary beams as the forms extend over the tops of the primary beams and receive no direct support therefrom and it is therefore not necessary to dimension the forms so that one or more forms fills in each rectangle between the primary and secondary beams as would be the case if the forms were supported on both the secondary and primary beams at the same level.

When props are used to support the support beams the props may be of the construction described in our British Patent Application No. 28728/73 (Serial No. 1,457,135). As described in this application, the drop heads are removable from the props. Alternatively, the props may be substantially of the construction described in our British Patent Specification No. 1,195,366. Where moulds are used, in formwork embodying the invention, these may be of the construction described in our British Patent Specification No. 1,192,928 and/or in our British Patent Specification No. 1,202,287.

In a scaffolding in accordance with the present invention both end portions of the or each intermediate secondary beam may rest on their respective primary beams.

Alternatively, for the or each rectangle a first end portion of the or each intermediate secondary beam rests on one of the primary beams of the rectangle and is provided with a support structure for the other end portion of a similar intermediate secondary beam of an adjacent rectangle, the other end portion of the or each intermediate support beam of the first mentioned rectangle being supported from the other primary beam of the rectangle by the support structure of the first end portion of a further similar intermediate secondary beam of a further adjacent rectangle or some other support structure resting on or otherwise supported by said other primary beam.

In a still further alternative arrangement both end portions of the or each intermediate secondary beam are engaged with and extend between saddles located on the primary beams on opposite sides of the rectangle, a support plate carried by, or forming part of, each saddle forming part of the casting surface for the soffit.

In the various alternatives described above each end portion of an intermediate secondary beam which rests on a primary beam or each saddle may be located against movement longitudinally of the primary beam by a projection or aperture on or in the primary beam which is received in or receives an aperture or projection in or on the intermediate secondary beam or saddle.

A stabilising plate may be secured to each end portion of an intermediate secondary beam which rests on a primary beam or to each saddle, the stabilising plate resting on the primary beam and projecting beyond the end portion of the beam or saddle in order to stabilise the intermediate beam against tipping about the longitudinal axis of said intermediate beam.

When both ends portions of an interme-

diate secondary beam rest on the primary beams the intermediate beam may be provided with a projection adjacent each end, the projection adjacent one end of the intermediate beam being fixed relative to said beam and the projection adjacent the other end being movable longitudinally of said beam to allow installation of said beam on the primary beams. Alternatively, both end portions of the intermediate beam may be bolted to their respective primary beams.

In arrangements in which both end portions of the intermediate beam or beams are supported by saddles or in which only the first end portion rests on one of the primary beams, the saddle or first end portion may be located on the associated primary beam by providing the primary beam with a projection in the form of a head of a locking key having a shank which passes through an aperture in the primary beam and is secured therein by a wedge passing through an aperture in the shank. Alternatively the first end portion or saddle may be located against movement longitudinally of the primary beam by two abutments secured to the primary beam at positions spaced longitudinally of the primary beam, a part of the end portion or saddle extending between said abutments thereby locating the end portion or saddle.

In arrangements in which the intermediate secondary beams are supported on saddles each secondary beam may have, adjacent each end thereof, abutments which extend transversely, and outwardly from opposite sides of the beam, the abutments at each end being arranged to be received by a saddle or a lower head on a vertical scaffold element to engage the beam therewith. Preferably also, in such an arrangement, each primary beam has such abutments at the ends thereof and may be identical with the secondary beams in order to be interchangeable therewith.

In arrangements in which only the first end portion of each intermediate secondary beam rests on one of the primary beams, the other end portion of each intermediate secondary beam may be provided with abutments which extend transversely and outwardly from opposite sides of the beam, the abutments being arranged to be received by the support structure supported by said other primary beam. In such an arrangement the support structure may comprise a retroverted hook-like flange which forms part of the first end portion of said further similar intermediate secondary beam or part of a saddle supported by said other primary beam.

The support structure and other end portion may be provided with an interengageable projection and aperture arrangement which locates said other end portion against movement longitudinally of said other primary beam. Each end of each secondary beam extending between the lower heads of vertical scaffold elements may also be provided with transversely extending abutments for engagement with a lower head. Also each primary beam may have transversely extending abutments adjacent each end thereof for engagement with a lower head.

Each lower head of the vertical scaffold elements preferably has a pair of spaced recesses to receive the transversely spaced abutments on a secondary beam end, the recesses themselves being shaped to hold the abutments therein against substantial movement longitudinally of said secondary beam or alternatively holding means being provided for this purpose.

In a preferred construction, each lower head has four pairs of recesses, two pairs at a higher level and arranged at diametrically opposite positions with respect to the vertical scaffold element to receive the abutments on the ends of two secondary beams and two further pairs of recesses arranged at diametrically opposite positions with respect to the vertical scaffold element at a lower level to receive the abutments of primary beams when, as is preferred, the primary beams are provided with such abutments.

The two pairs of recesses at the higher level may be provided by cut-outs adjacent the ends of two parallel L-shaped angle brackets, the brackets being supported at diametrically opposite positions on the vertical scaffold element in an inverted back to back arrangement, the two pairs of recesses at the lower level being provided by cut-outs in a similar pair of L-shaped angle brackets at the lower level, the two pairs of angled brackets extending at right angles to each other. In such an arrangement the cut-outs may engage the beam abutments to locate the beams against movement transverse to the lengths of the beams.

Alternatively the two pairs of recesses at the higher level may be provided by two pairs of lugs which are bent up from a higher plate, each pair of lugs being respectively associated with a projection on the higher plate which holds the beam abutments in the recesses, the two pairs of recesses at the lower level being provided by two pairs of lugs which are bent up from a lower plate and are provided with similar holding projections. In such an arrangement the adjacent edges of the pairs of lugs engage the sides of the beams to locate the beams against movement transverse to the lengths of the beams.

Where saddles are employed to support the intermediate secondary beams each saddle may have a first part located on a primary beam and a second part telescoped

within an end portion of the intermediate secondary beam with which the saddle is engaged, the first part of the saddle carrying the support plate. Means may be provided for releasably inter-connecting the intermediate secondary beam and the second part of the saddle which is telescoped therein.

For example, the intermediate secondary beam and the second part of the saddle may be inter-connected by a key passing through co-operating apertures in the saddle and the secondary beam, the key being held in position by a wedge passing through an aperture in the key.

The first part of each saddle is preferably provided with a recess to engage the abutments on a further secondary beam. This recess is preferably provided by a retroverted hook-like flange formed on a plate which forms part of the saddle.

The secondary beams will normally have longitudinal flanges to support forms such as moulds or panels and will preferably be of top-hat section. Where moulds are used their edge portions which are to be supported by the flanges are of lesser thickness than the peripheral flanges which are provided on panels. The peripheral flanges on such panels are arranged to rest directly on the longitudinal secondary beam flanges and thus if, as is preferred, the same secondary beams are to be used in supporting panels and/or moulds it is necessary to pack the longitudinal flanges when using moulds and heretofore this has been done with wooden battens. The secondary beams may thus be provided with releasable means for holding battens on the flanges in order that the secondary beams can be used with moulds or panels of different thicknesses. Conveniently the releasable means may take the form of nut and bolt assemblies which extend through aligned apertures in the battens and secondary beams.

The invention will now be described in detail by way of example with reference to the accompanying drawings in which:—

Figure 1 is a perspective view, partly exploded, of part of a scaffolding embodying the present invention;

Figure 2 is a side elevation of the lower head of one of the props shown in Figure 1;

Figure 3 is a plan view of the head of Figure 2;

Figure 4 is an under-plan view of a panel which may be used in the scaffolding of Figure 1 but shown at a different scale;

Figure 5 is a section on the line 5—5 of Figure 4;

Figure 6 is a perspective view of an alternative form of drop head arrangement suitable for use in the scaffolding shown in Figure 1;

Figure 7 is an exploded perspective view of an alternative saddle arrangement suitable for use in the scaffolding shown in Figure 1;

Figure 8 is a side view, partly in section, of a further alternative saddle arrangement;

Figures 9 and 10 are side and sectional views respectively of an alternative intermediate secondary beam arrangement, and

Figure 11 is a side view, partly in section, of a further alternative intermediate secondary beam arrangement.

Referring now to Figures 1, 2 and 3 this shows part of a scaffolding for supporting forms such as panels or moulds (not shown) for the casting of a concrete floor. The scaffolding comprises four props 10, 11, 12 and 13 arranged at the corners of a rectangle. Each prop comprises a vertical element 9 having an upper head 14 at the upper end thereof. The upper heads have downwardly extending flanges 15 adjacent their ends. Each prop also includes a lower head assembly indicated generally at 16, the lower head assembly being supported on a load pin 17 which passes through a pair of aligned apertures, not shown, in the vertical element 9 and which engages a threaded collar 18 engaged with a threaded sleeve 19 forming part of the lower head assembly.

The threaded sleeve 19 is provided with a pair of diametrically opposed slots, one of which is shown at 21 and these receive the load pin 17. The collar 18 is provided with a pivoted handle 20 whereby it can be rotated relative to the sleeve 19 and hence the height of the lower head assembly adjusted relative to the remainder of the prop.

The construction of the lower head assembly will now be described in detail with reference to Figures 2 and 3.

Welded to the upper end of the sleeve 19 is a square section sleeve 19^1 to which is welded an upper pair of L-shaped cross section angle brackets 22. These brackets are provided adjacent their ends with cut-outs or recesses 23 which, as will be described, receive abutments at the ends of the secondary beams. Such an abutment is indicated in Figure 2 at A and is mounted on a secondary beam B which has a shoulder S which is engaged by one of the downwardly extending flanges 15 on the upper head 14.

A lower pair of L-shaped cross section angle brackets 24 are also welded to the sleeve 19^1. These lower brackets 24 are provided with cut-outs 23^1 and are identical to the upper brackets 22 but are arranged at an angle of 90° thereto. It will be appreciated that the upper brackets 22 can support the ends of two beams in line and that the lower brackets 24 can also support the ends of two beams in line, the beams supported on the lower brackets being at right angles, when considered in plan view, to

the beams supported by the upper brackets. A plate 25 welded between the lower brackets 24 carries a pair of pins 26 which may be used to secure bracing pieces in position as will be described below.

Returning now to Figure 1, the part of the scaffolding there shown comprises two primary beams 36 and 37 which are supported on the lower brackets 24 of the lower head assemblies 16 on the props 10 to 13. Four secondary beams 38, 39, 40 and 41 are shown. The secondary beams 38 and 40 are supported on the upper brackets 22 of the lower head assemblies 16. The secondary beams 39 and 41, hereinafter referred to as intermediate secondary beams, are supported from the primary beam by saddles in a manner which will be described below.

Referring, by way of example, to the secondary beam 38, this is of top-hat section and comprises an upper web 42, side flanges, one of which is indicated at 43 and lower out-turned flanges one of which is indicated at 44. The top-hat section is reinforced by a lattice girder construction indicated generally at 45. Formed in each side flange 43 is a plurality of apertures 46, each aperture is in the form of a slot with a central circular portion 47.

At each end of the beam, the side flanges 43 are provided with lugs 48 to which is welded a cross rod 49. The rod 49 extends transversely of the beam beyond the side flanges 43 and provides a pair of abutments 50 constituted by the end portions of the rod. As will be seen, these abutments are received in the cut-outs 23. It will also be seen that the downwardly extending flange 15 on each upper head engages shoulders 51 provided by the upper edges of the lugs 48.

As shown, the primary beams 36, 37 are of identical construction to all the secondary beams in order to allow the maximum possible interchangeability of the beams. This is not essential however and the primary and secondary beams may be of different construction.

Referring now to the intermediate secondary beams 39 and 41, these are supported from the primary beams by means of saddles. One such saddle is indicated at 57. The saddle comprises a member 58 of box section having secured to the upper surface thereof a packing piece 59. A support plate 60 is secured to the packing piece. Welded to each side of the member 58 are two small packing pieces, one of which is shown at 61. At the left hand end of the saddle there is provided a bent plate 62 which has a part 63 which is welded to one end of the box section member 58 and which has a retroverted hook-like flange 64, a recess 65 being provided between the flange 64 and the part 63.

The left hand part 67 of the saddle comprises a first part to the base of which a stabilising plate 66 is secured. As can be seen from a consideration of the saddle 68 at the left hand end of the beam 39 in Figure 1 this stabilising plate 66 rests on the primary beam 36 thus increasing the area of contact of the saddle with the primary beam and stabilising the beam 39 against tipping about its longitudinal axis. The second part of the saddle which comprises the right hand portion thereof is telescoped within the secondary beam 39. The packing pieces 59 and 61 engage the upper web and side flanges of the beam and thus locate the beam relative to the saddle. It will be noted that the upper surface of the support plate 60 is flush with the upper surface of the web 42 of the secondary beam with which the saddle is engaged. When the saddle is engaged in the intermediate secondary beam the box member 58 rests on a plate (not shown) which is welded to the under part of the beam and extends between the flanges 44.

The saddle is held in position on the intermediate secondary beam by means of a connecting key 69 which passes through an aperture 70 in the member 58 and through an aperture such as 71 in a plate 72 welded to the under part of the secondary beam, such a plate being shown, by way of example, for the secondary beam 41. The key 69 is passed first through the aperture 70 and then through the aperture 71 and is secured in position by means of a wedge 73 which passes through an aperture 74 in the key. The apertures 70 and 71 are similar to the apertures 46 and are in the form of a slot with a central circular portion. The slot receives the key 69 and the central circular portion enables a bolt to extend therethrough so that a nut and bolt assembly can be used in place of the key 69 and wedge 73 in order to secure the saddle to the intermediate secondary beam.

The saddle is located longitudinally on the beam 36 by means of a locating piece 75 which comprises two angle pieces 76 welded to a connecting plate 77 in order to define an opening 78 therebetween. The locating piece 75 is bolted to the beam 36 by a nut and bolt assembly 95 which passes through an aperture 96 in the connecting plate 77 and one of the apertures 46 in the beam 36. The lower part of the plate 62 of the saddle is received in the opening 78 thus locating the saddle on the beam 36. Two locating plates 75 can be secured to the beam in a back to back arrangement on opposite sides of the beam as shown in Figure 1. This enables the saddles, such

as 68, to be arranged with their second parts extending to either side of the beam.

The intermediate secondary beam 39 is located between the secondary beams 38 and 40 by means of two saddles, the saddle 68 referred to in the left hand end of the beam and a similar saddle indicated at 79 in the right hand end of the beam. The saddles are held in the ends of the beam by means of the keys 69 and wedges 73 and are located longitudinally of the primary beams 36 and 37 by means of the locating plates as described.

The lower flanges 44 of the secondary beams are of such a size to support the flanges of panels as will be described below, so that the upper surfaces of the panel are flush with the upper surfaces of the webs 42 of the secondary beams. As has been described above, if it is desired to use moulds, the moulds have edge portions which are less deep than the flanges of the panels and it is thus necessary to pack up the edge portions by means of a batten. Such battens are shown mounted on the secondary beam 41.

The battens are indicated at 97 and are held in position by means of nut and bolt assemblies 98 which extend through the apertures 46 in the beam 41.

Figures 4 and 5 show a panel for use with the support scaffolding arrangement described above to form a completed formwork system for the casting of a concrete floor. The panel comprises a sheet 92 of plywood having a peripheral flange as is indicated at 93. Formed in the flange are a number of apertures some of which are indicated at 94 and which, when the free edge of the flange rests on a lower flange such as 44 of the secondary beams, are aligned with the apertures 46. Connecting keys (not shown) may thus be passed through the beam and the flanges such as 93 to hold the panels in position.

The apertured peripheral flanges of the panels and the connecting keys may also be used to cantilever the panels from the secondary beams for a small distance to provide, for example, a walkway along the edge of the formwork. The apertures in the secondary beams and the connecting keys may also be used to secure a hand rail to a secondary beam.

In the arrangement described above the upper surfaces of the secondary beams 38, 39 and 40, the upper heads 14 of the props and the support plates 60 of the saddles all form, in combination with the upper surface of the panels or moulds, the casting surface of the formwork. Also, the intermediate secondary beams rest on the primary beams 36 and 37 and the panels or moulds supported by the flanges 44 of the secondary beams are arranged so that the lower surfaces of the panels or moulds are above the upper surfaces of the primary beams. This gives complete freedom as to the dimensions of the panels or moulds in directions parallel to the secondary beams as the panels or moulds extend over the tops of the primary beams and receive no direct support therefrom. This offers considerable advantages over an arrangement in which the primary and secondary beams are supported at the same level, as in such an arrangement it would be necessary for the dimensions of the panels or moulds to be such that one or more panels or moulds fitted exactly into the rectangles between the primary and secondary beams.

The operation of the system is conventional. If the heads 14 are secured rigidly to the props then a portal frame may be made up of two props such as 10 and 11 with a secondary beam 38 between them by first mounting the secondary beam on the lower head assemblies 16 while these are spaced downwardly from the heads 14 and then rotating the collars 18 to move the lower head assemblies upwardly until the flanges 15 of the upper heads 14 engage with the shoulders 51 on the secondary beams. Two such portal frames may be made up, the second being made up with the props 12 and 13 and the secondary beam 40 and these may then be inter-connected by the primary beams 36 and 37. A bracing piece which extends diagonally across each rectangle of props, i.e. from prop 10 to prop 12, may be secured in position using the pins 26 in order to facilitate assembly of the scaffolding. Alternatively, if the design of the floor requires or allows a primary beam to be omitted at any point, a bracing piece can be used in place of the primary beam and held in place using the pins 26. When the portal frames are made up the upper surfaces of the upper heads 14 which constitute support plates are level with the upper surfaces of the webs 42 of the secondary beams 38 and 40.

The intermediate secondary beams can now be placed in position. With one beam such as 39, it is necessary to put a saddle 68 and 79 in each end thereof so as to support the beam from both primary beams. The saddles will be inserted into the secondary beams and secured therein as described and will also be located longitudinally relative to the primary beam as described. As the scaffolding is extended, a further intermediate secondary beam such as 41 will only need the saddle in one end thereof because the cross rod 49 at the right hand end of the beam 41 will fit into the recess 65 in the plate 62 on the saddle 58. It is also to be noticed that the upper surfaces of the intermediate secondary beams such as 39 and 41 and the upper surfaces

of the support plate 60 on the saddles are at the same level as the upper surfaces of the upper heads 14 and the upper surfaces of the secondary beams 38 and 40. Thus as described above, these surfaces form part of the casting surface of the formwork system.

The formwork is completed by either panels supported from the flanges 44 of the secondary beams or moulds supported from battens 97 supported on the flanges 44. The concrete is then poured, the soffit of the floor being formed by the casting surface of the formwork. After the concrete has cured sufficiently, the lower head assemblies can be lowered by means of rotating the collars 18 and the primary and secondary beams removed together with the panels or moulds leaving the props supporting the concrete by the upper heads or support plates 14. The props will be maintained in position until the concrete is sufficiently cured for them to be removed.

The lower drop head assemblies have been shown as being of the conventional type with a threaded sleeve such as 19, but it is within the scope of the invention to provide removable drop head assemblies.

Figure 6 shows an alternative form of prop head arrangement suitable for use in the support scaffolding shown in Figure 1 in which components similar to those previously described in relation to Figures 1 to 3 have been similarly numbered.

In the arrangement shown in Figure 6, the upper end of the threaded sleeve has an upper plate 101 welded thereto. At opposed ends of the plate 101 are provided pairs of lugs 102 and 103 respectively which are bent upwardly. An upstanding pin 104 is welded to the upper plate 101 between the lugs 102 and a corresponding pin 105 is welded between the lugs 103. As can be seen from Figure 6, the end portions 50 of the rod 49 on the secondary beam 38 are received and held in position between the lugs 102 and the pin 104 and the lugs 102 locate the beam 38 against transverse movement via lugs 48.

A lower plate 106 is welded to the sleeve 19 below the upper plate 101. This lower plate is identical in construction to the upper plate 101 but is secured to the sleeve 19 at an angle of 90° to the upper plate. The lower plate has pairs of lugs 107 and and 108 and co-operating pins, only one of which is visible at 109 in Figure 6. The lugs 107 and 108 on the lower plate 106 can thus support a primary beam or beams such as 36 at right angles to the secondary beam or beams supported by the upper plate 101. Strengthening webs 110 are welded to the sleeve 19 between the upper and lower plates.

The remaining features of the prop head arrangement are identical to those previously described with reference to Figures 1 to 3 and will not therefore be further described.

Figure 7 shows an alternative saddle arrangement which is basically similar to that previously described with reference to Figure 1 and in which components similar to the previously described arrangement have been similarly numbered.

The modifications shown in Figure 7 consist in the provision of two upwardly extending lugs 111 on the flange 64 and the use of a locating key 112 to longitudinally locate the saddle on the beam 36. This locating key replaces the locating piece 75 described in Figure 1. The key 112 is received in a pair of aligned apertures 46 of the beam 36 and is provided with a head 116 which projects from the side flange 43 of the beam 36 and engages an aperture 113 provided in the plate 62 of the saddle. The key 112 is held in position on the beam 36 by a wedge 114 which extends through an aperture 115 in the key 112 and engages the other side flange 43 of the beam. The engagement of the head 116 of the key 112 in the aperture 113 of the saddle locates the saddle longitudinally on the beam 36.

The right hand portion of Figure 7 shows the alternative saddle arrangement received in telescopic relation in the end of the intermediate secondary beam 39 of Figure 1. The saddle 68 is not shown in its operative position on the primary beam 36 but in an upward exploded position. Also the key 112 is omitted from the right hand portion of Figure 7.

Figure 8 shows an alternative saddle arrangement in which the saddle 150 is received in telescoped relation within the end of an intermediate secondary beam 151. The saddle is provided with a support plate 60, a packing piece 59 and a stabilising plate 66 as previously described with reference to Figure 1. The saddle is mounted on a primary beam 152 which includes a metal capping strip 153 welded thereto.

The saddle 150 includes a bent plate 154 having a retroverted hook like flange 155 which provides a recess 156 which receives a transversely extending cross rod 157 welded below the other end of a similar intermediate secondary beam 158.

The saddle 150 is located on the primary beam 152 by a projection in the form of a rod 159 welded to the outer face of the retroverted hook 155. One end 160 of this rod extends through one of a number of apertures 161 in the primary beam similar to the apertures 46 previously described with reference to Figure 1. Engagement of the end 160 of the rod 159 with the aperture 161 locates the saddle 150 on the primary 152 against movement longitudinally of the primary beam.

The other end 162 of the rod 159 extends through an aperture 163 provided in a plate 164 welded to the base of the intermediate secondary beam 158. The engagement of the end 162 of the rod in the aperture 163 locates the intermediate secondary beam 158 against displacement transverse to its longitudinal axis. The aperture 163 is elongated longitudinally of the secondary beam 158 in order to facilitate assembly of the secondary beam 158 on the saddle 150.

As indicated above, the right hand end (not shown) of the intermediate secondary beam 151 is identical to the right hand end of the intermediate secondary beam 158. The secondary beam 151 is also therefore provided with cross rods 157 at both ends in order that either end of this secondary beam can be engaged with the saddle 150.

At the edge of the scaffolding the primary beams are provided with saddles only one side of which is engaged with an intermediate secondary beam. For example, only one side of the saddle 79 in Figure 1 is engaged by the intermediate secondary beam 39. When using a saddle arrangement of the form shown in Figure 8, at the edge of the scaffolding a saddle such as the saddle 150 described above will be employed, in the manner of the saddle 79 of Figure 1, with the bent plate 154 in back to back relation with the bent plate 154 on the saddle employed at the other end of the intermediate secondary beam. Thus, for example, if the right hand end of the intermediate secondary beam 151 were to be supported on one of the outermost primary beams of the scaffolding, the saddle 150 engaged with the right hand end of the intermediate secondary beam 151 would have its bent plate 154 extending outwardly to the right of the intermediate secondary beam 151.

Alternatively, in the arrangement shown in Figure 1, if the props 11 and 12 were positioned along part of an outer edge of the scaffolding the primary beam 37 could be omitted and the end of the intermediate secondary beam 39 which is supported by the saddle 79 in Figure 1 could alternatively be supported by a further vertically extending prop. This alternative arrangement in which the primary beams are omitted along the outer edges of the scaffolding can be employed in all the saddle arrangements described in this specification.

Figures 9 and 10 show part of an alternative intermediate secondary beam arrangement for use in a scaffolding in accordance with the present invention. In the arrangement shown in Figures 9 and 10 an intermediate secondary beam 170 is provided with an end portion 171 which rests on a primary beam 172. As can be seen from Figure 9, the end portion 171 extends half way across the primary beam 172. The other end of the intermediate secondary beam 170 (not shown) is provided with a similar end portion which also extends half way across a primary beam.

The intermediate secondary beam 170 is located on the primary beams by two projections one at each end of the intermediate secondary beam. The projection at the end of the secondary beam 170 which is not shown in Figure 9 is fixed and extends through an aperture in the primary beam similar to the apertures 46 shown in Figure 1. The projection at the end of the intermediate secondary beam shown in Figure 9 comprises a wedge 173 which is slidable in slots (not shown) in support flanges 174 welded to the base of the intermediate secondary beam 170. The end 175 of the wedge 173 is arranged to extend through one of a number of apertures 176 in the primary beam 172 which are similar to the apertures 46 shown in Figure 1. The end 175 of the wedge is dimpled at 177 to prevent the removal of the wedge from the support flanges 174. The slots in the flanges 174 are dimensioned to cooperate with the wedge 173 to provide a wedging action when the wedge 173 is driven through the aperture 176.

As can be seen from Figure 10, the intermediate secondary beam 170 comprises a main box section member 178 to which is welded a flat plate 179 which provides support surfaces 180 for panels or moulds etc. A plywood strip 181 is secured to the strip 179 in order to maintain the panels or moulds supported by the beam in the correct spaced relationship. The width of this plywood strip may be adjusted, if necessary, in order to accommodate manufacturing inaccuracies in the panels or moulds employed.

As can be seen Figure 9, at the end portion 171 the lower part of the box section 178 is removed and a plate 182 is welded across the box section in order to provide a seating surface for engagement with a metal capping strip 183 which forms part of the primary beam 172.

If desired, intermediate secondary beams may be provided with an end portion which rests on the primary beams in the manner described with reference to Figures 9 and 10 and may be secured to the primary beams using nut and bolt assemblies in place of the wedge arrangement described above.

Figure 11 shows a further alternative intermediate secondary beam arrangement in which an intermediate secondary beam 180 of similar cross-section to that shown in Figure 10 is provided with an end portion 181 which rests on and extends completely across a primary beam 182. The portion of

the beam 182 in Figure 11 is provided with a wedge 173 similar to that previously described with reference to Figures 9 and 10 which again extends through one of a number of apertures provided in the primary beam 182 in order to locate the secondary beam 180 against movement longitudinally of the primary beam 182.

As can be seen from Figure 11, the end portion 181 of the secondary beam 180 is provided with a bent plate 183 which has a retroverted hook portion 184 which defines a recess 185 which receives a cross rod 186 welded to the base of the other end of a similar intermediate secondary beam 187. Thus, the right hand end (not shown) of the intermediate secondary beam 180 is identical to the right hand end of the intermediate secondary beam 187.

The hook portion 184 is provided with a central projection 188 which extends through an aperture 189 in an L-shaped plate 190 welded to the right hand end of the intermediate secondary beam 187. Thus the engagement of the projection 188 in the aperture 189 locates the intermediate secondary beam 187 against displacement transverse to its longitudinal axis.

As referred to above, the intermediate secondary beams 180 and 187 are similar in cross-section to the beam shown in Figure 10. The beams thus again include metal strips 192 which provide support surfaces 193 for moulds or panels etc. and a plywood strip 194 to maintain the correct spacing between the panels or moulds.

In the intermediate beam arrangements shown in Figures 9 to 11 no saddles are employed. As will be evident from a consideration of the construction shown in Figure 1, when the saddle 68 is secured to the intermediate secondary beam 39 the resultant composite component is similar to the intermediate secondary beam 180. Thus the arrangement for locating the saddles on the primary beams shown in Figure 1 may be employed in intermediate secondary arrangements of the form shown in Figure 11 in which no separate saddle is employed. Similarly, the various features of the saddle arrangements shown in Figures 7 and 8 may also be employed as part of an intermediate secondary beam of the form shown in Figure 11 in which no separate saddle is employed. Also, as referred to above, at the edge of a scaffolding, the primary beams may be omitted and beams of the form shown in Figure 11 may be supported at their outer end portions on props.

The present invention thus provides an improved scaffolding for formwork of the kind specified in which, by providing intermediate secondary beams which are not supported directly on vertical scaffold elements, the vertical scaffold elements employed can be more heavily loaded and hence used more efficiently. Also, by providing the support surfaces on the secondary beams above the upper surfaces of the primary beams, so that the forms receive no direct support from the primary beams complete freedom is given as to the dimensions of the forms in directions parallel to the secondary beams.

WHAT WE CLAIM IS:—

1. A scaffolding for supporting forms to the soffit of a structural element to be cast comprising a plurality of vertical scaffold elements each supporting an upper head and a lower or drop head movable vertically relative to the upper head between an upper or operative position and a lower or stripping position, the scaffold elements being arranged at the corners of rectangles, a plurality of mutually parallel horizontal primary beams extending between and engaged with the lower heads of adjacent scaffold elements, a plurality of mutually parallel horizontal secondary beams extending between and engaged with the lower heads of adjacent scaffold elements, the primary and secondary beams being arranged at right angles to each other so that the beams engaged with four scaffold elements arranged at the corners of a rectangle are two primary beams and two secondary beams and lie along the sides of the rectangle, an intermediate secondary beam supported from and extending between the primary beams on opposite sides of a rectangle, the upper surfaces of all the secondary beams and of the upper heads forming parts of a casting surface for the soffit, and support surfaces on the sides of the secondary beams for supporting said forms between adjacent secondary beams, said support surfaces being above the upper surfaces of the primary beams.

2. A scaffolding according to Claim 1 in which two or more intermediate secondary beams are supported from and extend between the primary beams on opposite sides of at least one of the rectangles.

3. A scaffolding according to Claim 1 or Claim 2 in which both end portions of the or each intermediate secondary beam rest on their respective primary beams.

4. A scaffolding according to Claim 1 or Claim 2 in which for the or each rectangle a first end portion of the or each intermediate secondary beam rests on one of the primary beams of the rectangle and is provided with a support structure for the other end portion of a similar intermediate secondary beam of an adjacent rectangle, the other end portion of the or each intermediate support beam of the first mentioned rectangle being supported from the other primary beam of the rectangle by the sup-

port structure of the first end portion of a further similar intermediate secondary beam of a further adjacent rectangle or some other support structure resting on or otherwise supported by said other primary beam.

5. A scaffolding according to Claim 1 or Claim 2 in which both end portions of the or each intermediate secondary beam are engaged with and extend between saddles located on the primary beams on opposite sides of the rectangle, a support plate carried by, or forming part of, each saddle forming part of the casting surface for the soffit.

6. A scaffolding according to any one of Claims 3 to 5 in which each end portion of an intermediate secondary beam which rests on a primary beam or each saddle is located against movement longitudinally of the primary beam by a projection or aperture on or in the primary beam which is received in or receives an aperture or projection in or on the intermediate secondary beam or saddle.

7. A scaffolding according to any one of Claims 3 to 6 in which a stabilising plate is secured to each end portion of an intermediate secondary beam which rests on a primary beam or to each saddle, the stabilising plate resting on the primary beam and projecting beyond the end portion of the beam or the saddle in order to stabilise the intermediate beam against tipping about the longitudinal axis of said intermediate beam.

8. A scaffolding according to Claim 6 or 7 when dependent on Claim 3 in which the or each intermediate secondary beam has a projection adjacent each end, the projection adjacent one end of the intermediate beam being fixed relative to said beam and the projection adjacent the other end being movable longitudinally of said beam to allow installation of said beam on the primary beams.

9. A scaffolding according to Claim 3 in which both end portions of the or each intermediate secondary beam are bolted to their respective primary beams.

10. A scaffolding according to Claim 6 or 7 when dependent on Claim 4 or Claim 5 in which the primary beam is provided with a projection in the form of a head of a locking key having a shank which passes through an aperture in the primary beam and is secured therein by a wedge passing through an aperture in the shank.

11. A scaffolding according to Claim 4 or Claim 5 in which each end portion of an intermediate beam which rests on a primary beam or each saddle is located against movement longitudinally of the primary beam by two abutments secured to the primary beam at positions spaced longitudinally of the primary beam, a part of the end portion or saddle extending between said abutments thereby locating the end portion or saddle.

12. A scaffolding according to Claim 11 in which the two abutments are mounted on a connecting member which is bolted to the primary beam.

13. A scaffolding according to Claim 5 or any one of Claims 6, 7 and 10 to 12 when dependent on Claim 5 in which each secondary beam has, adjacent each end thereof, abutments which extend transversely and outwardly from opposite sides of the beam, the abutments at each end being arranged to be received by a saddle or a lower head on a vertical scaffold element to engage the beam therewith.

14. A scaffolding according to Claim 4 or any one of Claims 6, 7 and 10 to 12 when dependent on Claim 4 in which the other end portion of each intermediate secondary beam is provided with abutments which extend transversely and outwardly from opposite sides of the beam, the abutments being aranged to be received by the support structure supported by said other primary beam.

15. A scaffolding according to Claim 14 in which the support structure comprises a retroverted hook-like flange which forms part of the first end portion of said further similar intermediate secondary beam or part of a saddle supported by said other primary beam.

16. A scaffolding according to Claim 14 or Claim 15 in which the support structure and other end portion are provided with an interengageable projection and aperture arrangement which locates said other end portion against movement longitudinally of said other primary beam.

17. A scaffolding according to any one of Claims 14 to 16 in which each end of each secondary beam extending between the lower heads of vertical scaffold elements is also provided with transversely extending abutments for engagement with a lower head.

18. A scaffolding according to any one of Claims 14 to 17 in which each primary beam also has transversely extending abutments adjacent each end thereof for engagement with a lower head.

19. A scaffolding according to Claim 18 when dependent on Claim 13 in which the primary and secondary beams are interchangeable.

20. A scaffolding according to Claims 13 or 17 in which each lower head has a pair of spaced recesses to receive the transversely spaced abutments on a secondary beam end, the recesses themselves being shaped to hold the abutments therein against substantial movement longitudinally of said secondary beam or alternatively holding means being provided for this purpose.

21. A scaffolding according to Claim 18 and 20 in which each lower head has four pairs of recesses, two pairs at a higher level and arranged at diametrically opposite positions with respect to the vertical scaffold element to receive the abutments on the end of two secondary beams and two further pairs of recesses arranged at diametrically opposite positions with respect to the vertical scaffold element at a lower level to receive the abutments of primary beams.

22. A scaffolding according to Claim 21 in which the two pairs of recesses at the higher level are provided by cut-outs adjacent the ends of two parallel L-shaped angle brackets, the brackets being supported at diametrically opposite positions on the vertical scaffold element in an inverted back to back arrangement, the two pairs of recesses at the lower level being provided by cut-outs in a similar pair of L-shaped angle brackets at the lower level, the two pairs of angled brackets extending at right angles to each other.

23. A scaffolding according to Claim 22 in which the cut-outs engage the beam abutments to locate the beams against movement transverse to the lengths of the beams.

24. A scaffolding according to Claim 21 in which the two pairs of recesses at the higher level are provided by two pairs of lugs which are bent up from a higher plate, each pair of lugs being respectively associated with a projection on the higher plate which holds the beam abutments in the recesses, the two pairs of recesses at the lower level being provided by two pairs of lugs which are bent up from a lower plate and are provided with similar holding projections.

25. A scaffolding according to Claim 21 in which adjacent edges of the pairs of lugs engage the sides of the beams to locate the beams against movement transverse to the lengths of the beams.

26. A scaffolding according to Claim 5 or any one of Claims 6, 7, 10 to 12 and 17 to 24 when dependent on Claim 5 in which each saddle has a first part located on a primary beam and a second part telescoped within an end portion of the intermediate secondary beam with which the saddle is engaged, the first part of the saddle carrying the support plate.

27. A scaffolding according to Claim 26 in which means are provided for releasably interconnecting the intermediate secondary beam and the second part of the saddle which is telescoped therein.

28. A scaffolding according to Claim 27 in which the intermediate secondary beam and the second part of the saddle are interconnected by a key passing through cooperating apertures in the saddle and the secondary beam, the key being held in position by a wedge passing through an aperture in the key.

29. A scaffolding according to Claim 28 in which each intermediate secondary beam is of inverted channel section, an apertured web being secured across the mouth of the channel to receive the key.

30. A scaffolding according to any one of Claims 26 to 29 when dependent on Claim 13 in which the first part of each saddle is provided with a recess to engage the abutments on a further secondary beam.

31. A scaffolding according to Claim 30 in which the recess is provided by a retroverted hook-like flange formed on a plate which forms part of each saddle.

32. A scaffolding according to any one of Claims 1 to 31 in which the beams at the corners of the rectangles are supported on double-headed props of variable length.

33. A scaffolding according to any one of Claims 1 to 32 in which the secondary beams are provided with longitudinally extending flanges which provide, or support battens which provide, the support surfaces.

34. A scaffolding according to Claim 33 in which the secondary beams are provided with releasable means for holding battens on the flanges in order that the secondary beams can be used with forms of different thicknesses.

35. Formwork for the casting of a structural element comprising a scaffolding according to any one of Claims 1 to 34 with forms supported between adjacent secondary beams on the support surfaces so that the lowermost parts of the forms are above the upper surfaces of the primary beams, there being a single row of forms between each adjacent pair of secondary beams.

36. A scaffolding for supporting forms to the soffit of a structural element to be cast, the scaffolding being constructed and arranged substantially as hereinbefore described and as shown in Figures 1 to 3 of the accompanying drawings.

37. A scaffolding for supporting forms to the soffit of a structural element to be cast, the scaffolding being constructed and arranged substantially as hereinbefore described and as shown in Figures 1 to 3 and modified as shown in Figure 6 of the accompanying drawings.

38. A scaffolding for supporting forms, to the soffit of a structural element to be cast, the scaffolding being constructed and arranged substantially as hereinbefore described and as shown in Figures 1 to 3 and modified as shown in Figure 7 of the accompanying drawings.

39. A scaffolding for supporting forms to the soffit of a structural element to be cast, the scaffolding being constructed and arranged substantially as hereinbefore described and as shown in Figures 1 to 3 and

modified as shown in Figure 8 of the accompanying drawings.

40. A scaffolding for supporting forms to the soffit of a structural element to be cast, the scaffolding being constructed and arranged substantially as hereinbefore described and as shown in Figures 1 to 3 and modified as shown in Figures 9 and 10 of the accompanying drawings.

41. A scaffolding for supporting forms to the soffit of a structural element to be cast, the scaffolding being constructed and arranged substantially as hereinbefore described and as shown in Figures 1 to 3 and modified as shown in Figure 11 of the accompanying drawings.

42. Formwork for the casting of a structural element, the formwork being constructed and arranged substantially as hereinbefore described with reference to Figures 1 to 5 of the accompanying drawings.

43. Formwork for the casting of a structural element, the formwork being constructed and arranged substantially as hereinbefore described with reference to Figures 1 to 5 and modified as shown in Figures 6 or 7 or 8 or 9 and 10 or 11 of the accompanying drawings.

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1457136 COMPLETE SPECIFICATION

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Sheet 1

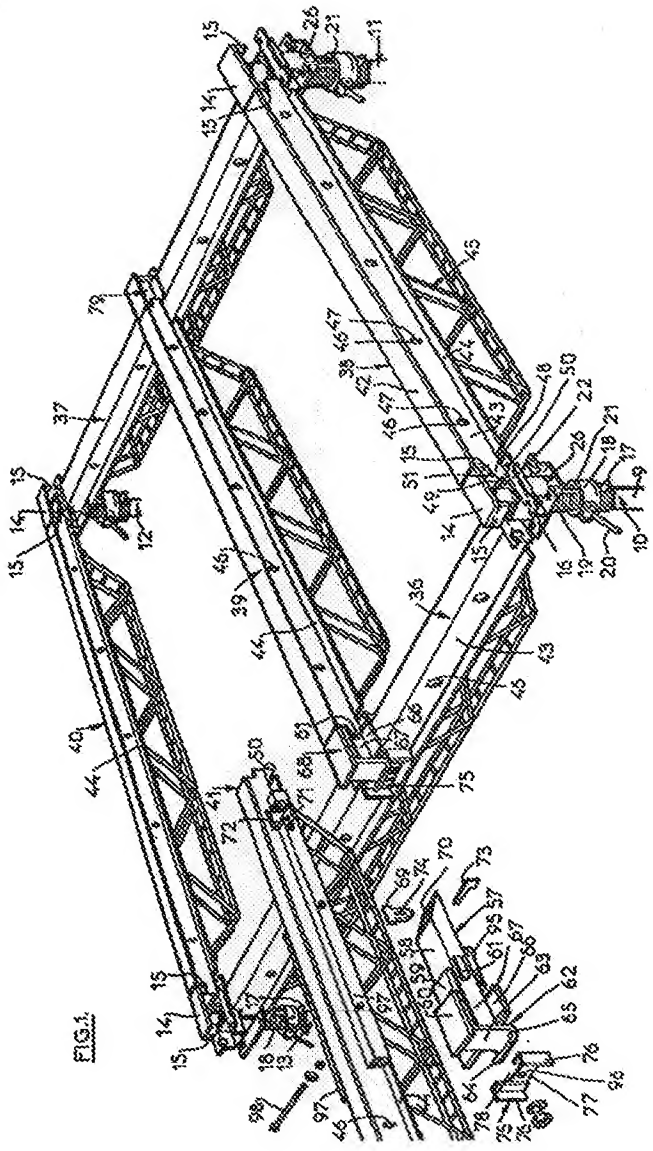

FIG.1.

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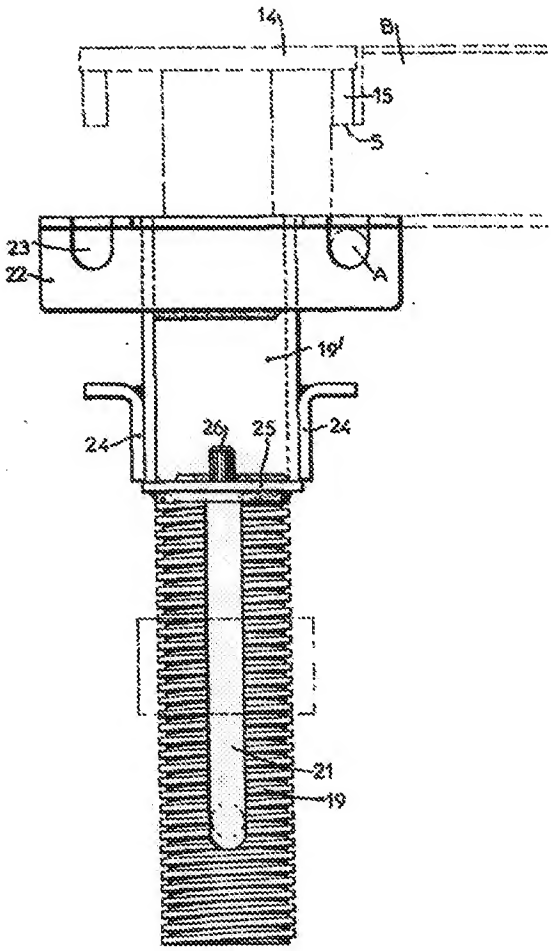


FIG.2.

FIG.3.

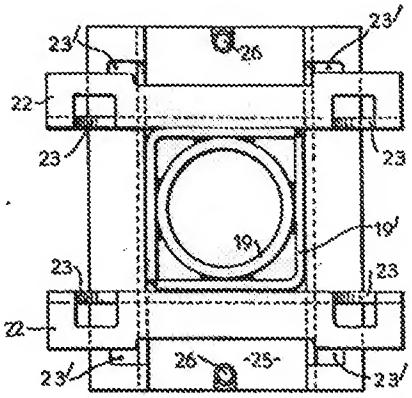


FIG.6.

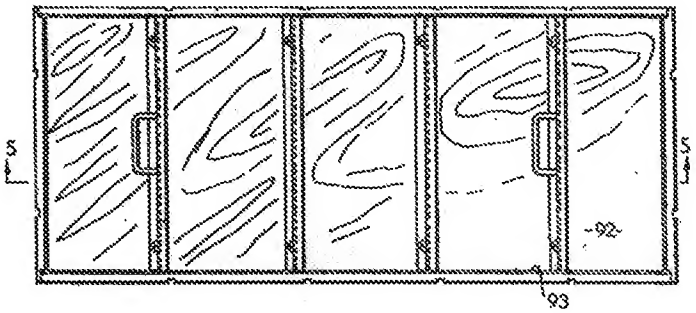
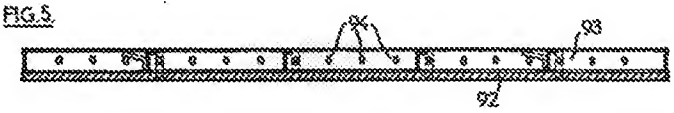


FIG.5.



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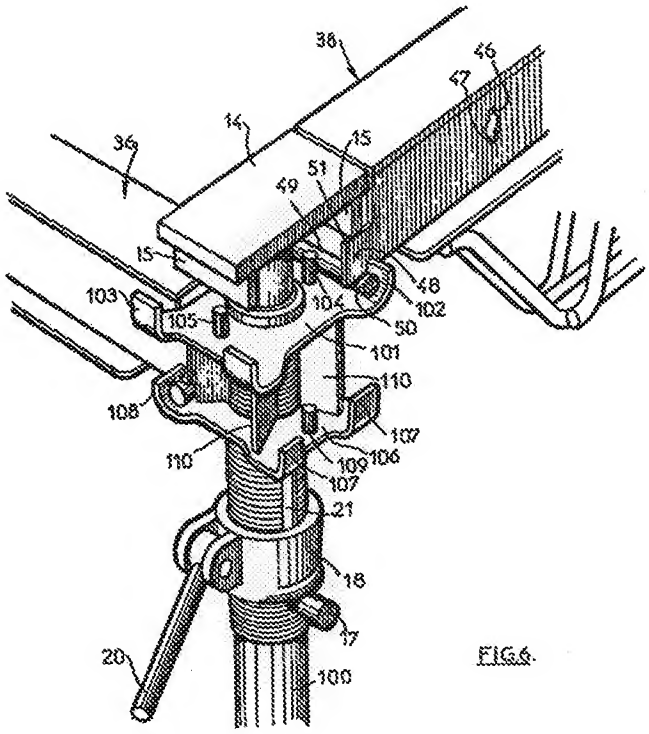

FIG.6.

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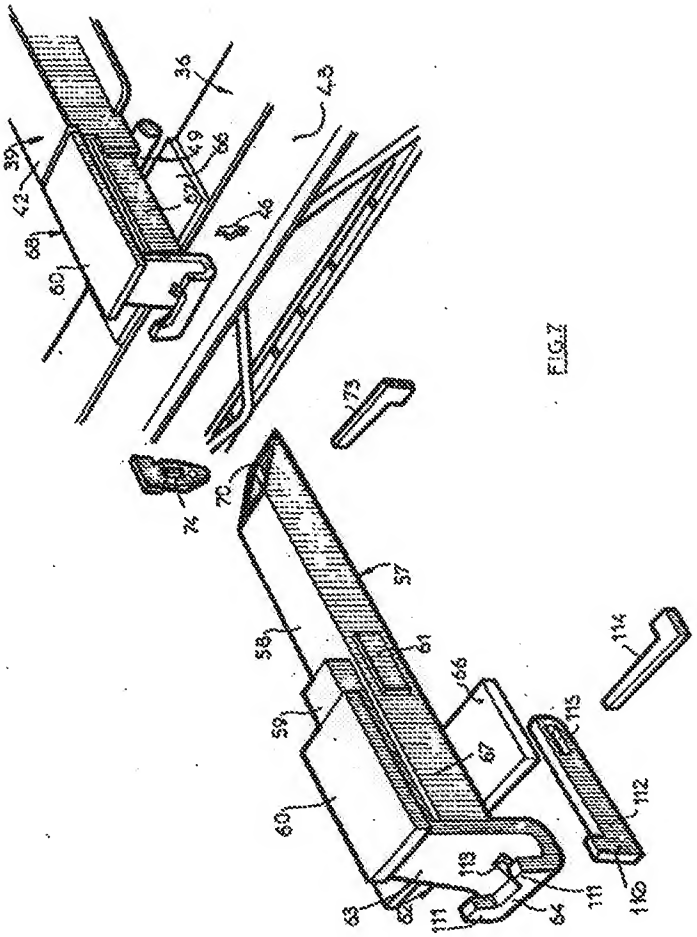

FIG.7

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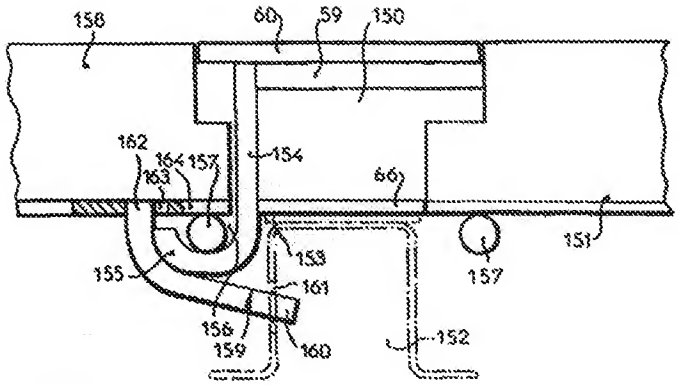
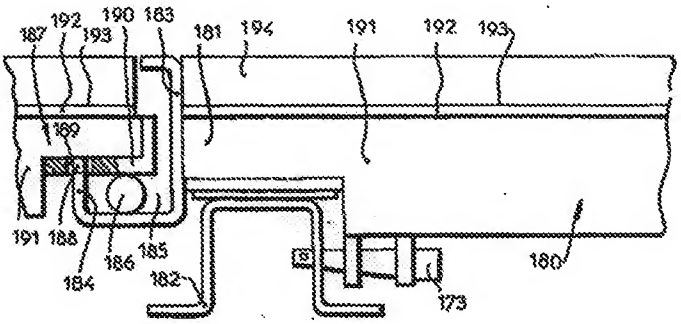


FIG. 8.

FIG. 11.



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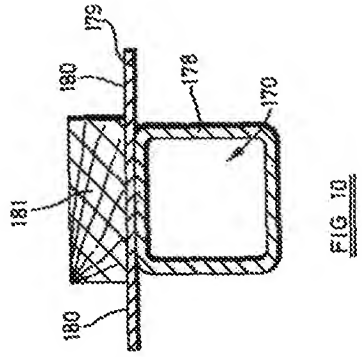

FIG 10

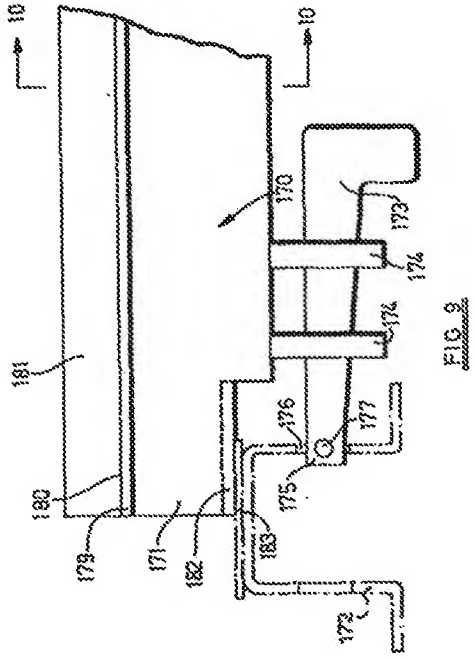

FIG 9